R E P O R T R E S U M E S

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A FEASIBILITY STUDY IN EFFICIENT INSTRUCTIONAL USE OF DIGITAL COMPUTERS.

BY- HOWELL, JOHN M.
LOS ANGELES CITY SCHOOLS, CALIF.

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THROUGH A REVIEW OF LITERATURE, STUDIES OF EMPLOYMENT OPPORTUNITIES, AND VISITS TO JUNIOR COLLEGES IN WASHINGTON AND CALIFORNIA, GUIDELINES WERE DEVELOPED FOR DATA PROCESSING PROGRAMS IN THE LOS ANGELES JUNIOR COLLEGES. ACCORDING TO ONE STUDY, IN BUSINESS APPLICATIONS, 70 PERCENT OF EMPLOYEES HAD A.A. DEGREES OR LESS. IN SCIENTIFIC APPLICATIONS, 13 PERCENT HAD SIMILAR TRAINING. ANNUALLY, APPROXIMATELY 4,000 JOB OPENINGS ARE AVAILABLE IN LOS ANGELES FOR DATA PROCESSING GRADUATES. EIGHTY-EIGHT PERCENT OF RESPONDENTS TO A SURVEY WERE WILLING TO EMPLOY GRADUATES OF JUNIOR COLLEGE DATA PROCESSING PROGRAMS. SPECIALIZED PROGRAMS ARE NEEDED FOR BUSINESS AND SCIENTIFIC APPLICATIONS, AND FOR COMPUTER TECHNOLOGY SERVICES, WITH PROGRAMS FOR SPECIAL NEED OF TRANSFER STUDENTS. EACH LOS ANGELES JUNIOR COLLEGE SHOULD HAVE A DATA PROCESSING CENTER WITH A LIBRARY WORK CENTER. LABORATORY HOURS SHOULD BE INCREASED IN ALL PHASES OF THE PROGRAM. MOST EFFECTIVE TEACHING IS DONE BY PROFESSIONAL TEACHERS WITH SPECIALIZED DATA PROCESSING BACKGROUND. CURRICULUM PROPOSALS, FACILITY LAYOUTS, AND BIBLIOGRAPHY ARE INCLUDED. (WO)

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A Report Designed to Develop Guidelines for
the Growth of Data Processing Programs
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by John M. Howell, Associate Professor
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April, 1964

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Los Angeles City Schools
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A Feasibility Study in Efficient Instructional Use of Digital Computers

was prepared by the Division of College and Adult Education

450 North Grand Avenue

Los Angeles 12, California

Dr. T. Stanley Warburton, Associate Superintendent

Division of College and Adult Education

Mr. Walter T. Coultas, Assistant Superintendent of Junior Colleges

Dr. Jack P. Crowther, Superintendent of Schools

Dr. Louise W. Seyler, Deputy Superintendent

Los Angeles City School Districts

ADMINISTRATIVE OFFICES: 450 North Grand Avenue, Los Angeles 12, California
MADISON 5-8921 MAILING ADDRESS: Box 3307, Terminal Annex, L. A. 54

JACK P. CROWTHER
Superintendent of Schools

T. STANLEY WARBURTON
Associate Superintendent
Division of College
and Adult Education

WALTER COULTAS
Assistant Superintendent

April 3, 1964

Dr. T. Stanley Warburton
Associate Superintendent
Division of College and Adult Education
Los Angeles City Board of Education
450 N. Grand Avenue
Los Angeles 12, California

Dear Dr. Warburton:

For more than the calendar year of 1963, Mr. John Howell, Associate Professor of Mathematics at Los Angeles City College, has been engaged in a study of the equipment needs for the growing instructional programs designed to train college students in the uses of electronic digital computers. This study has been conducted with the assistance of the National Defense Education Act, Title VIII, under the encouragement of the Bureau of Business Education, California State Department of Education. The Los Angeles junior colleges have been fortunate in receiving aid and direction for this study through the good offices of Mr. Lee Baldwin, Assistant Chief, Bureau of Business Education, who has been authorized by Mr. R. C. Van Wagenen, Chief of the Bureau of Business Education, to give special attention to the research project.

It has become increasingly apparent that a knowledge of the business uses of digital computers is rapidly becoming indispensable for dealing with the large body of data involved in modern business transactions. The Los Angeles junior colleges have accepted the challenge to determine the extent of educational involvement in the training of programmers and analysts.

Mr. John Howell has had an unusual background for conducting the present study. In addition to his pioneering experience at Los Angeles City College where he has taught computer mathematics, he has had extensive experience in the industrial field as a process analyst and has for many years taught in the University Extension for U.C.L.A. a course in statistical Quality Control Principles and Operations. Mr. Howell's procedure in approaching a determination of equipment needs in computer hardware for junior college instructional programs has taken him throughout the State of California and to Washington State for a comparative assessment of current instructional methods. In his visits he has been particularly assisted by Mr. Robert McKee, Supervisor of Technical Education, Olympia,

Washington; Robert R. Arnold and Arnold Hill of San Diego City College; Philip Nash, Monterey Peninsula College; and Gilbert Saunders, of Orange Coast College. Within the Los Angeles City Junior College District he found ready at hand an enthusiastic contributor to this study in Mr. Kenneth Parsons of Metropolitan College. Mr. Parsons was instrumental in collecting a body of opinion from business and industry relative to the employability of junior college graduates trained in this field. This material was analyzed by Mr. Howell and is included within the present volume. A special note of recognition must be given to Mr. Benjamin K. Gold, Counselor at Los Angeles City College. Mr. Gold has been very effective in developing several of the college's self-studies in institutional research and has advised Mr. Howell in regard to the form of data presentation.

Mr. Howell has produced a work that is distinguished by its succinctness and practicality. He answers the question, "Under what conditions is it desirable for a college to purchase a digital computer to be used for demonstration and practice in the teaching of programming?"

I am confident that the Los Angeles Junior College District and other colleges and districts will find his recommendations both practical and stimulating in projecting further developments in a field of training that will play a large role in preparing for employment in the age of automation.

Respectfully submitted,

Gilbert S. Moore

Gilbert S. Moore
Administrative Coordinator

GSM:lb

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REPORT ON "A FEASIBILITY STUDY IN EFFICIENT INSTRUCTIONAL USE OF COMPUTERS WITHIN THE LOS ANGELES JUNIOR COLLEGE DISTRICT"

I. BACKGROUND

The Importance of Computers

In assessing the role of the computer in modern civilization, observers are inclined to generous use of superlatives. The following quotes by responsible authorities illustrate current estimates of the situation:

> "No other technical innovation has changed so many human activities in so short a time. An extension of man's brain-power, it is transforming science, medicine, government, education, defense, business. It may transform man himself." [1]
>
> "The electronic computer has a more beneficial potential for the human race than any other invention in history." [2]
>
> "When the history of our age is written, I think it will record three profoundly important technological developments: nuclear energy, which tremendously increases the amount of energy available to do the world's work; automation, which greatly increases man's ability to use tools; and computers, which multiply man's ability to do mental work.. Some of our engineers believe that of these three, the computer will bring the greatest benefit to man." [3]

1. Gilbert Burck, "The Boundless Age of the Computer," Fortune March 1964, p. 101
2. Ibid, quoting Mr. Ray Eppert, President of Burroughs Corporation
3. Ralph J. Cordiner, "Business Week Reports to Readers on Computers," Business Week, June 21, 1950

The above statements do not appear overly extravagant. The computer now affects the lives of all. It has changed technological evolution into near revolution. It has changed military strategy. It has affected fundamental principles of business management. It has opened new horizons in basic scientific research. It has influenced power structure in economic and political organizations. It has brought into use new methods in teaching and learning. Money spent for computers and their accompanying electronic processing systems by business, government, and the military now total over $4 billion per year.

The electronic digital computer is here to stay, and its already profound impact upon modern life is certain to become even greater.

What is a computer? Many people think of the computer as a "giant brain," others as some sort of magic, others as a panacea for their problems. Closer to the truth is the statement that a computer is actually a moronic high speed adding machine. The computer does only what it is instructed to do, as many students in their first course in programming[1] (preparing a set of coded instructions for a computer) find to their dismay. In essence the computer can perform only three operations. It can (1) add, (2) remember, and (3) compare. By adding negative numbers it can subtract, by adding repeatedly it can multiply, and by adding repeated subtractions it can divide. It is thus able to perform all the arithmetic processes. By processes of storing information in a manner similar to that of a home tape recorder, it can memorize and retrieve information upon command. The most unique and significant function that the computer performs is that of comparison. It can follow

1. A glossary of some of the terms related to the computer as used in this report may be found in Appendix A.

one of two courses of action dependent upon the result of the comparison, and in this sense performs a "decision-making" function. It is this "decision-making" ability which makes a computer different from a desk calculator or an accounting machine.

Computers have been programmed to prepare weather maps, play games, control production lines, solve "unsolvable" differential equations, design structures, compose music, control traffic, compute payrolls, control satellites, transmit communications, translate foreign languages, write poetry, and diagnose diseases. In all these performances, however, the computer performs the three operations mentioned above in the manner that the programmer instructs. The computer approaches the "thinking" realm when the programmer instructs the machine to learn from its own experience! This has inspired someone to write a new definition of thinking as that which computers cannot do.

Oversimplifying the case somewhat, a computer's uses can be divided into two broad classifications: (1) electronic data processing (EDP), and (2) research in mathematics and science.

Data processing is the refinement and recording of statistical information by manual, mechanical or electronic means. It involves three major activities: input (recording), processing (classifying) and output (summarizing). Recently the term "electronic data processing" (EDP) has become specially associated with automated, or computer and punched card data processing. The heart of any EDP installation is the electronic computer. EDP usually comes into a business first through the accounting function where it simply does unit record shuffling faster. Some companies confine the use of computers to calculating payrolls and other

accounting functions, while others find applications in inventory control, speeded delivery dates, pricing, order verification, scheduling, market forecasting, and distribution planning.

Of all the areas affected by computers, none has undergone a more thorough change than research in mathematics and science. The computer enables the mathematician to solve equations which were solvable by elementary methods but required so much time and effort their solution could not be undertaken, simply because the mathematician would not live long enough. It enables him to solve by numerical methods and approximations problems which have no known theoretical solutions. For the scientist and engineer, the computer helps build bridges, automobiles, chemical plants, and bombs. It detects and analyzes atomic particles in atom smashers. It shows how missiles will perform before they are built. It analyzes causes of highway traffic jams. The applications are endless. New and complex avenues are open to the researcher.

A third computer use that has recently come into being is that of control of mechanical and chemical processes. Although new, this development will undoubtedly be of increasing importance in the future. The operation is known as "real time operation", i.e., processing data in time with a physical process so that results of the data processing are useful in guiding the physical operation.

In and near Los Angeles, junior college interest in the computer originated primarily in the mathematics department and emphasis was placed on the mathematics-science research use. In most other areas investigated in this study, interest started in business departments of the college

with data processing use in mind. In fact, many of the latter colleges still do not offer computer courses for mathematics and science students.

The Computer in the Junior College

The computer is a reality. Its significance is great, its importance unquestioned. The question then arises as to what education, particularly the junior college, should do about it. Why particularly the junior college? The junior college has traditionally served two types of students: (1) the student who plans to transfer to a four year college or university but who, for various reasons, spends his first two years in a junior college; and (2) the student who requires some but less than four years of college for his particular vocational objective. As will be documented later in this report, both of these types of students have tremendous opportunities for employment in electronic data processing and scientific applications of the computer.

In answering the question of what should education, particularly collegiate schools of business, do about EDP, Dr. Robert T. Tussing, Head, Business Administration, New Mexico Highlands University, Las Vegas, New Mexico,suggested six choices:

1) Remain aloof until other institutions develop a general pattern for EDP
2) Encourage research projects in EDP
3) Sponsor conferences, seminars, workshops devoted to presentations of basic information, to case experiences, to sharing ideas
4) Offer programming and operator training courses for a particular EDP system

[4] Robert T. Tussing, "Consideration of the Place of EDP in the College Curriculum," Collegiate News and Views, December, 1962

5) Add, to the content of existing courses, material relating to the equipment, methods and potential of EDP in order to orient students to basic possibilities and problems brought about by EDP.

6) Develop a full fledged major field of study in the area of systems and controls.

After discussing the merits and demerits of the above alternatives, and deciding that alternatives one and four are inappropriate, Dr. Tussing concludes with some significant comments:

"The equipment is available; the need is plain; the objectives are generally understood. ...The key to efficient and effective utilization of EDP equipment is people--people who can plan, organize, visualize, and think! ...Analyses of the experiences and characteristics of people who are successful as project analysts and analyst - programmers on EDP installations have emphasized the need for certain abilities, education, and experience in the following areas: business and accounting data processing applications; systematic organization of work; logical reasoning and evaluation of alternatives; mathematics and quantitative analysis; and communication, both oral and written ... Basic principles of physics, electricity, and engineering that affect the capacity and logic of a computer need to be understood if the machine is to be fully utilized. These principles must be presented either in a separate course or as an integrated part of other business courses."

Careers in business and industry are available now, and will certainly become more varied and numerous, to those who are prepared to meet the new challenges presented by the advent of the computer. As Tussing

indicates, the key to the situation is people who can plan, organize, visualize and think.

The fact that the junior college will play a significant role in the training of people for employment in the computer age is clear. Not so clear are the details as to how that role might best be played. Many questions arise:

1) How much of a financial investment should be made in computer "hardware?"

2) What types of computers should be made available?

3) Is it better to purchase equipment outright or to lease it?

4) What are the best physical arrangements for efficient use of the equipment?

5) How can adjustments be made to account for obsolescence of equipment?

6) Are two year vocational-technical curricula adequate for employment in the field?

7) What are guide lines for setting up curricula?

8) For the transfer student going into the field, what are appropriate lower division courses?

9) Which department should teach computer programming?

10) What is the place of the computer in the general education program?

11) Should life and social science majors have a course in the computer?

12) How are teachers selected and trained for the program?

13) Should evening courses be available for the part-time student?

These questions are only a sample of the myriad that must be faced as the junior colleges plan to meet the challenges posed to them in the age of the computer.

The Los Angeles City Junior Colleges

California's tripartite system of public higher education is unmatched in any other state. The three-way partnership of university, state college, and junior college as spelled out by the so-called Master Plan, adopted by the State legislature in 1960, indicates an ever-expanding role for the junior college. By 1975, 50,000 students who would have attended their first two college years at a state college or the university will attend a junior college. The junior college, according to the Master Plan, is to offer instruction in:

"(1) standard collegiate courses for transfer to higher institutions;

(2) vocational and technical fields leading to employment; and

(3) general or liberal arts courses." (5)

In addition to its increased responsibilities in the first area, preparation for employment in fields using the computer presents a tremendous challenge to the junior colleges. The place of the computer in general education also commands attention.

California's seventy-four public junior colleges serve some 400,000 students, almost half the number served nationwide, and more than those enrolled in lower division in all other colleges and universities in the state. Largest of the junior college districts in California is the Los Angeles City Junior College district, including seven junior colleges and serving some 70,000 students nearly half of whom are full-time day students.

The Los Angeles City Junior College District with its seven junior colleges offers to the Southern California area a unique system of higher education. The policy of the Board of Education of the district is to permit each college to serve the needs of its particular community, with no effort to standardize curricula except in liberal arts courses where standardization is necessary for transfer to four year institutions. Thus, each college is an individual entity, offering or giving emphasis to curricula and courses to meet its own local community needs, not necessarily patterning its own program after that of a sister college or a district "norm."

The oldest and largest college in the district is Los Angeles City College, founded in 1929, and located in the heart of central Los Angeles. Serving 8,500 full time students and another 7,800 part-time evening students, Los Angeles City College offers over fifty two-year technical-vocational curricula, as well as programs to meet the needs of its students who transfer to four year institutions. City College transfer students number over 1,200 per year and enroll in a variety of colleges, with about 600 attending California State College at Los Angeles and 300 attending U.C.L.A. The vocational-technical curricula unique to City College include, among others, Broadcasting-Telecasting, Dental Assistants, Linguistic Receptionist, Ophthalmic Optics, Paint Manufacture, Professional Travel Guide, X-Ray Technology, and Digital Computer Technology. Now under construction on the Los Angeles City College campus is one of the finest Theater Arts Buildings in the nation.

Also serving a large number of transfer students is East Los Angeles College, founded in 1945 to serve the growing needs of the eastern portion of the Los Angeles area. East Los Angeles College now enrolls 3,700 full time day

students and an additional 5,800 part time. One of this college's unique functions is that of offering off-campus classes at federal, county, and city administrative offices. Vocational-technical curricula unique to East Los Angeles College include Medical Assistant, Ceramic Engineering Technology, Social Welfare Aide, and Machine Design Technology.

Valley College is one of two Los Angeles junior colleges serving the expanding San Fernando Valley area, Founded in 1949, Valley College is now the second largest of the Los Angeles City junior colleges with a current enrollment of 5,800 full time and 7,100 part time students. Valley College has placed emphasis on cultural fields, such as art, drama, and music. Vocational-technical curricula offered uniquely by Valley College include Tool Design, Journalism Technical Writing, and Physical Science Technology - Radiation and Nuclear Major.

Farther west in the San Fernando Valley, Los Angeles Pierce College is located in a once-rural farming area. The college was founded in 1943 as the Clarence W. Pierce School of Agriculture, with the purpose of offering technical and practical agricultural training for students planning to engage in agricultural pursuits. In response to changing community needs, the college in 1951 broadened its offerings and today offers a strong transfer program in addition to its vocational-technical curricula. The college now attracts 4,000 full time and 5,800 part time students. Pierce boasts its own dairy as well as numerous other agriculture fields in which students specialize.

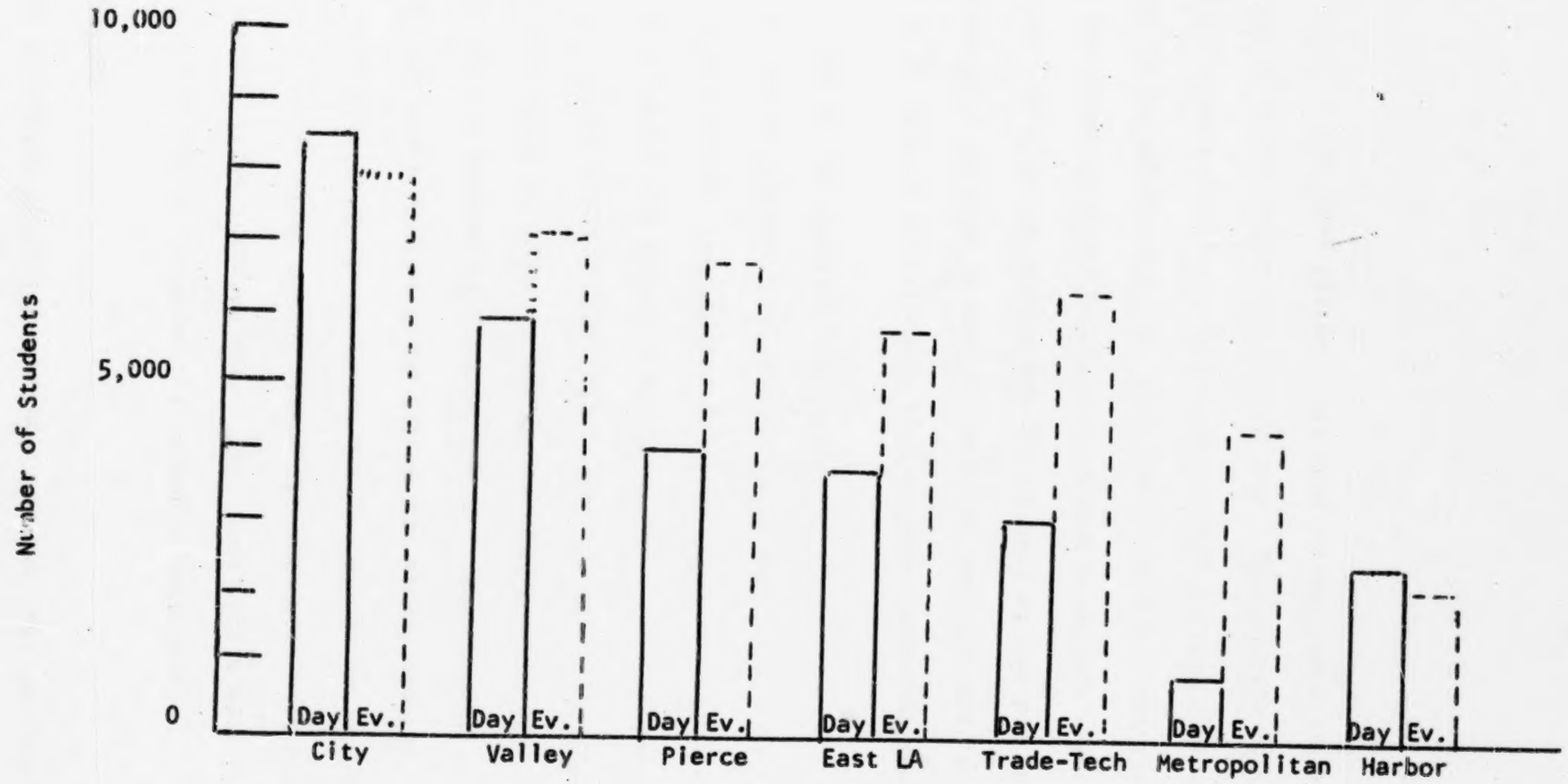
At the other geographical extreme of the junior college district, Los Angeles Harbor College is located near the complex waterfront oil fields. Opened in 1949, Harbor College now serves 2,400 full time and 2,200 part time students. In addition to its vocational-technical offerings in Petroleum Refining, Harbor College offers curricula in Automation and Instruments, Chemical Technology,

Engine Technology, Water Pollution Control Technology, Machine Tool Technology, and Manufacturing Technology.

The other two Los Angeles City junior colleges are strongly vocational-technical oriented, offering little transfer work. Both were made a part of the Los Angeles junior college system after having served the community with distinction as trade schools. Los Angeles Trade-Technical Junior College has a history dating back to 1925 when the Frank Wiggins Trade School was established to meet the need for a centralized program of trade education. Advancement in technology and a higher age level of students led to the transferring of the school in 1949 to junior college status. The college now enrolls 3,100 full time and 6,300 part time students and offers a wealth of technical-vocational curricula, including Fashion Design, Merchandise Display, Technical Illustration, Automotive Trades, Construction Trades, Cosmetology, Radio and Television Technician, Furniture Upholstering, Welding, and others.

Los Angeles Metropolitan College is an outgrowth of the former Metropolitan School of Business established in 1936 to meet a community need for post high school business training. In 1950 the school was made a part of the Los Angeles junior college system and today is still primarily a business college. Current enrollment at Metropolitan College is 900 full time and 4,400 part-time students. Unique vocational-technical curricula offered by the college include Freight Traffic Management, Machine Bookkeeping, and Stenography. The college offers several one-year curricula in business fields. Its role in BDP looms large in the future.

Enrollments in the Los Angeles City Junior Colleges, February, 1964



The Los Angeles City junior colleges, as are all public junior colleges in California, are tuition-free community "open-door" colleges. Admission is granted to all high school graduates and all other persons over eighteen years of age who are able to "profit from the instruction offered." The student bodies of the seven campuses are thus heterogeneous, representing varied backgrounds, abilities, and interests.

Because of the heterogeneity of the junior college student body, the impression is sometimes made that the two-year college does not attract able students. It is increasingly clear that this impression is erroneous. Although it is true that the junior college serves many who lack requirements for admission to a four-year college or university, it also serves many who do not lack such requirements but who attend the junior college for a variety of reasons, e.g., low cost, location near home, reputation of the junior college as a teaching institution, availability of evening classes, and availability of counseling and guidance services. Recent studies made at Los Angeles City junior colleges indicate that:

1) nearly half of those admitted to junior college were eligible to enter a State college.
2) transfers to the University of California and the State colleges from the junior colleges perform at a high level, doing as well as comparable students who take their first two years at the four year institution.
3) many students who were ineligible to enter the university as freshmen make up their deficiencies at a junior college and perform well after transfer to the university.

4) commendable records have been made by students who entered employment directly after completing their formal education in the junior college. The Los Angeles Association of Merchants and Manufacturers recently assessed the value of the two year college graduates over high school graduates in their employ as follows:

better prepared for job	71%
better adjusted at outset	61%
positive advantages in securing promotions	61%

In accord with the previously stated philosophy of administration of the Los Angeles junior colleges--that each college has, subject to State laws, Board of Education regulations, and Division policies, the freedom to develop that educational program most suitable to the interests and aptitudes of the students and to the needs of the community--courses and curricula in and related to the computer have been inaugurated at all seven of the colleges. Curricula in Data Processing have been started at Metropolitan College, City College, and Valley College. Computer technology curricula are now offered at East Los Angeles College, Valley College, and City College. City College has recently begun a program in Digital Computer Technology (operation and maintenance). All of the colleges offer one or more introductory courses in the uses of the computer. The following outline indicates the courses offered, together with enrollments in both day and evening classes, in the seven Los Angeles colleges in February, 1964.

Courses in and Related to the Computer

Los Angeles City College C
East Los Angeles College . . . . . E
Los Angeles Harbor College . . . . . H
Los Angeles Metropolitan College . . . . . M
Los Angeles Pierce College . . . . . P
Los Angeles Trade-Technical College . . . . . T
Los Angeles Valley College V

Business Data Processing

1. Principles of Business Data Processing I (3) CHTV
2. Principles of Business Data Processing II (3) CTV
11. Introduction to Punched Card Machines Accounting (3) M
12. Punched Card Accounting Systems and Management (3) M
21. Business Computer Programming I (3) CMP
22. Business Computer Programming II (3) M
23. Programming Laboratory (3) CV
25. COBOL Programming (3) M
27. Fortran Programming (3) M
31. Business Data Processing Systems (3) M
41. Electronic Data Processing in Accounting (3) M
51. IBM 1401 Programming I (3) M
52. IBM 1401 Programming II (3) M
53. IBM 1410 Programming (3) M
56. IBM 1620 Programming (3) M
60. Univac 1004 80/90 Programming (3) M

Electronics

18. Basic Computer Circuits (4) CEHPV
24. Basic Computer Circuits Laboratory (1) C
25. Computer Logic and Arithmetic (1) C
29. Numerical Control Systems (3) P
45. Digital Computer Systems (5) C
46. Digital Computer Systems Laboratory (2) C

Mathematics

27. Computers in Business and Social Sciences (3) CEV
44. Mathematical Elements of Computer Coding (3) C
60. Numerical Methods (1) HV
61. Introduction to Programming (2) CTV
62. Digital Computer Programming (3) TV
63. Advanced Computer Programming (3) CV

Electronics Technician (Trade and Technical)

17. Introduction to Systems Analysis (1)

Accounting

25. Accounting Methods and Procedures (3) CMV
26. Accounting Systems (3) CMV
37. Accounting Machines Practice (1-1) C

Automation

4. Automatic Control, Applications and Electronic Control (4) MPVH

Industrial Supervision

8. Work Simplification (3) HMPT

Management

48. Management Systems and Procedures MPV

Office Machines

15. Bookkeeping Machines (4-4) EHP
16. Machine Accounting (4) M
17. Typewriter Accounting Machines (4) HM
25. Two-register Accounting Machines I (2) M
26. Two-register Accounting Machines II (2) M
27. Multiple-register Accounting Machines I (2) M
28. Multiple-register Accounting Machines II (2) M

Enrollment in Classes, February 1964

		Los Angeles Metropolitan College			
		DAY		EVENING	
		Classes	Students	Classes	Students
BDP	1	2	57	8	390
	11			2	120
	12			1	32
	21			1	100
	25			1	29
	27			1	30
	31			1	31
	51	1	8	3	110
	52			2	68
	53			1	21
	56	1	6	1	38
	60			1	22
Math.	62			1	27
				73	1018
		East Los Angeles College			
Math.	61	1	19	1	21
	62	1	9	1	20
Off Mach.	15	1	7	2	14
				35	55

Enrollment in Classes, February, 1964

		DAY		EVENING	
		Classes	Students	Classes	Students
			Los Angeles City College		
BDP	1	1	52	1	37
	2	1	18	1	20
Electron	18	1	22	1	17
	24	1	18		
	25	1	41	1	25
	45	1	6		
	46	1	8		
Math	27	1	14	1	17
	44	1	33	1	21
	61	1	43		
	63	1	12		
Acctg	25			1	20
			267		157
			Los Angeles Valley College		
BDP	1	1	37	2	95
	2			1	22
Electron	18			1	38
Math	60	4	59		
	61	6	74	1	21
	62	2	36	1	31
	63	1	9		
			215		207
			Los Angeles Pierce College		
BDP	1	1	31	4	153
Electron	18	1	19		
Auto	4			1	17
Managemnt	48			1	43
			50		213
			Los Angeles Harbor College		
BDP	1			1	40
Math	60	1	15	1	17
	62	1	24	1	18
Off Mach	15	1	8		
			47		75
			Los Angeles Trade-Technical College		
BDP	1			1	17

There is no question but that offerings and enrollments in programs relating to the computer will increase tremendously over the next few years.

The Problem

In order to implement the programs described above, the Board of Education has provided for installation of a Bendix G-15 digital computer at City College, and an IBM 1620 at Valley, East Los Angeles, Harbor, Pierce, and Metropolitan Colleges. Except for the one at Metropolitan, each of the computers is under the supervision of the department of mathematics. At Metropolitan, the computer is supervised by the business department. Each computer above was acquired to meet the needs of a basic computer program for day students. However, the day offerings are supplemented by evening course offerings. In addition, Metropolitan College gives some off-campus courses for evening students on business premises where computer equipment of a specialized type is available.

In view of the large investment of the district in computer equipment for the laboratory installations of the mathematics department and the growing demands for laboratory facilities to serve the Business Data Processing curricula, the Board of Education felt that it was desirable to have available some information in anticipation of the growth of the enrollment in the various programs.

Several types of information were deemed essential if the growth of the computer programs were to proceed along orderly and efficient guidelines.

First, information was needed as to current employment possibilities open to Los Angeles junior college students completing a two-year curriculum in business data processing or mathematics-science computer applications.

Second, information was needed to aid in determining the nature and extent of equipment necessary to implement proposed courses and curricula.

Third, estimates were needed of the most efficient physical layout for optimun use of the equipment.

Fourth, information was needed as to the possibility of the equipment serving administrative and research functions of the college as well as the instructional function.

Fifth, it would be useful to know what other institutions were doing in effective and efficient scheduling of the use of computer equipment.

In short, the Board of Education felt that a rather thorough fact-gathering study was needed so that future planning in the areas involving the electronic computer could be based on thorough, relevant, and up-to-date facts.

II. OBJECTIVES OF THE STUDY

In January, 1963, the Superintendent of Schools in the Los Angeles School District presented a recommendation to the Board of Education that a feasibility study in efficient instructional use of computers within the Los Angeles Junior College District be undertaken. The broad objective of this study was to furnish a background of factual information and recommendations for the development of guidelines for the orderly and planned development of programs involving the use of electronic digital computers in the Los Angeles Junior College District. More specifically, the objectives of this study were:

1) to investigate and analyze the use of digital computers in junior college level programs throughout California and in selected situations outside the state.
2) to determine the areas and depth of employment opportunities in the Los Angeles area for junior college students majoring in business data processing and mathematics-science programs involving the use of a computer.
3) to evaluate the educational and financial feasibility of particular types of equipment.
4) to investigate and evaluate the efficiency and effectiveness of various types of physical layouts of facilities and various methods of scheduling the use of these facilities.
5) to develop a bibliography of teaching materials.
6) to recommend procedures and instruments for a continuing evaluation of the effectiveness of courses and curricula involving the digital computer.

7) to determine the extent to which computer installations in the junior colleges may serve the laboratory needs for special classes in the Los Angeles high schools.

The Superintendent's proposal to the Board of Education included the recommendation that financial support for the study be sought under the Title VIII of the National Education Defense Act, and that an appropriation be included for publication of the report of the study. This report represents the successful culmination of these efforts.

III. PROCEDURES OF THE STUDY

As the first step in the implementation of the proposed study, the Board of Education approved the appointment of Mr. John M. Howell, Associate Professor of Mathematics at Los Angeles City College, to conduct the study. Mr. Howell has taught mathematics at Los Angeles City College since 1946 and has taught computer programming since 1958. He has a broad background in statistics, having worked in industry as a statistician and having taught courses in Industrial Statistics at the University of California, Los Angeles extension. Mr. Howell was relieved of his teaching duties for the period of February, 1963 to February, 1964 and granted a half-time opportunity leave for this period in order to conduct the study.

In addition to the appointment of Mr. Howell, the following persons were named as a Resource Committee to assist and advise Mr. Howell:

William Cipriano	East Los Angeles College
James Cox	Curriculum Office
Dr. Bernard Fischer	Los Angeles City College
Al Abramson	Los Angeles City College
Stuart Friedman	Los Angeles Harbor College
Carmen Marinella	Los Angeles Harbor College
George Jaffray	Los Angeles Valley College
Robert Pilling	East Los Angeles College
Lloyd Cadbury	District Admissions
William Lewis	Los Angeles Valley College - Dean
Dr. George Goody	Evaluation and Research
Kenneth B. Parsons	L. A. Metropolitan College
Dr. Morris Heldman	L. A. Metropolitan College
Irving Drooyan	Los Angeles Pierce College
Arthur Anderson	Los Angeles Pierce College
Mary Alice Wittenberg	Supervisor, Business Education
Bessie B. Kaufman	Supervisor, Business Education
P. W. Thelander	Supervisor, Distributive Education
Dr. Gilbert S. Moore	Administrative Coordinator, Division of College and Adult Education
Virginia Munns	Los Angeles Valley College
Dale Carpenter	Supervisor, Mathematics--Junior/Senior High
Keith F. Smith	Supervisor, Science (Physical)--Senior High
Robert K. Eissler	Regional Supervisor, Bureau of Business Education, State Department of Education

The following methods were used to obtain the data upon which the findings and recommendations of this study are based:

1) Ten recent reports dealing directly with the problems under consideration in this study were read. A list of these reports is attached as Appendix B.

2) Current literature in the field was surveyed with a view toward preparing a bibliography of material which might be useful to those concerned in this area. The emergent bibliography is included in this report.

3) Manuals and other information provided by the major companies producing computer equipment were surveyed. Demonstrations of computers deemed possibly appropriate for junior college were attended. A list of the major suppliers of digital computers and other related equipment is appended to this report as Appendix D.

4) A two weeks course on programming the IBM 1620 was attended.

5) A survey of types of installations and employment opportunities in response to a questionnaire sent out by the Data Processing Management Association was tabulated and analyzed.

6) Visitations were made to Orange Coast College, Monterey Peninsula College, San Diego City College, and several junior colleges and Vocational-Technical Schools in the State of Washington.

7) Conferences called by the State Board of Education, Bureau of Business Education, at Fullerton, February, 1963,and at San Francisco, February, 1964,were attended.

IV. FINDINGS OF THE STUDY

Findings from the Literature

Three recent reports deal directly with the problem of developing guidelines for offering two-year college curricula in the field of electronics data processing. These are:

(1) Electronic Data Processing - I, A Suggested 2-year Post High School Curriculum for Computer Programers and Business Application Analysts. Technical Education Program Series No. 4, U.S. Department of Health, Education, and Welfare, Office of Education, 1963.

(2) Business Data Processing Technical Courses, Business Education Publication No. 105, California State Department of Education, May, 1962.

(3) Data Processing, A Suggested Two-Year Post High School Curriculum, State Board for Vocational Education, Olympia, Washington, August, 1963.

Each of these reports suggests courses to be offered in the business data processing curriculum, and makes recommendations as to hourly breakdown of courses into lecture and laboratory. Following is a summary of these recommendations.

It should be noted in the following summary that the California bulletin recommends basic mathematics and general education courses not included in the above summary. Inasmuch as schools in the state of Washington function under the quarter system, actual hours reported in the recommendations were adjusted to a semester basis for the purpose of comparison with the other recommendations. One notes immediately the greater laboratory emphasis in the state of Washington.

All three documents of the instructional programs of the foregoing embrace substantially the same basic core of courses:

1) a one semester introductory course
2) laboratory courses in unit record equipment
3) data processing mathematics
4) computer programming
5) systems and procedures

The Stanford Research Institute reported on the educational background of persons employed at sixty-two firms in California in their publication:

A Survey of the Educational Requisites for Technicians in Engineering and Scientific Data Processing Installations, Stanford Research Report, Menlo Park, California, prepared for the Bureau of Business Education, California State Department of Education, Sacramento, California, July, 1962.

Following is a summary of the findings of this survey. The table indicates the numbers of employees having the most advanced education indicated.

		BUSINESS			SCIENCE		
		HC	JC	COLL	HC	JC	COLL
1.	Electro-mechanical machine operator	63	2	1	4		
2.	Computer operator	26	1	5	7	60	
3.	Junior Programmer	2	29	3		20	19
4.	Programmer	104	35	52	6	5	348
5.	Senior Programmer		1	28			44
6.	Systems Analyst	25	11	28		1	72
7.	Programmer-analyst						210
	T O T A L S	227	79	129	17	87	699

In the business applications, 70% of the personnel had a junior college education or less. In the scientific applications, about 13% had junior college education or less. This report was made in July 1962 and not many students had completed a two year business data processing curriculum. It seems logical that many job openings would be filled by a two-year BDP graduate in preference to a high school graduate.

Recommended Courses and Hours per Week for Business Data Processing Two-Year Curriculum:

	U. S.		CALIF.		WASH.	
	Lect.	Lab.	Lec.	Lab.	Lec.	Lab.
First Year						
(First Semester)						
Data Processing Mathematics	3				3	
Introduction to Data Processing	2	1	3	2		
Electric Accounting Machine	2	5				15
Accounting	4		4		3	
Communication Skills	3					
Business Organization			3		3	
T O T A L	14	6	10	2	9	15
First Year						
(Second Semester)						
Data Processing Mathematics	4		3		3	
Data Processing Applications	2	1				
Computer Programming	3	4				5
Accounting	4		4		3	
Communication Skills	3				3	
Electric Accounting Machine			3	5		10
Statistics					2	
T O T A L	16	5	10	5	11	15
Second Year						
(First Semester)						
Computer Programming	3	5	3	2		8
Programming Systems	3	1				
Statistics	4		3		2	
Business Organization	2				2	
Cost Accounting	3		3			
Electric Accounting Machine			3	5		
Social Science					3	
Data Processing Mathematics					2	
Systems						7
T O T A L	15	6	12	7	9	15
Second Year						
(Second Semester)						
Business Systems	3	2	3	2	2	5
Computer Programming	4	4	3	2		10
Data Processing Field Projects	1	3	3			
Social Science	3				3	
Engineering Applications					2	
Electives					2	
T O T A L	11	9	9	4	9	15

In a report prepared by Calvin J. Goodman for the Los Angeles Board of Education in December, 1960, Education for Business Data Processing, numbers of jobs available in business data processing as of December, 1960 were indicated, and predictions were made for the number of additional jobs for 1965. The different kinds of data processing systems in use were in this report classified into three major classes: electromechanical accounting machines (EAM), small and medium scale computers, and large scale computers. The following table summarizes some of the information in this report.

	EAM Calculators	Small/Medium Computers	Large Computers
NUMBER OF INSTALLATIONS	53	24	9
Number of Employees			
Operator	783	542	479
Analyst	160	237	638
Management	115	77	159
T O T A L	1058	856	1276
* Estimated percent of total	20%	25%	30%
Average anticipated increase per installation by end of 1965			
Operator	24	41	62
Analyst	7	34	187
Management	4	3	31
Number of new jobs based on above predictions			
Operator	6360	3936	1860
Analyst	1855	3264	5010
Management	1060	288	930
Percent which are Junior College graduates or less			
Operator	96%	99%	99%
Analyst	82%	75%	67%
Management	84%	78%	61%

In the past, the majority of jobs which are filled by persons with a junior college education or less have been filled by those with high school education only. With adequate training in BDP, junior college graduates should fill a sizeable portion of the 4,000 jobs per year open to those with junior college education or less.

* Estimates for total Los Angeles area based on sample findings above

Findings from Questionnaire Survey

During the summer of 1962, Mr. Kenneth P. Parsons, Director of Education for Data Processing Management Association (formerly the National Machines Accountants Association) and Chairman of the Business Data Processing at Metropolitan College, made a questionnaire survey under the auspices of the DPMA to investigate the current employment situation in the industry. Replies were received from all parts of the country, but for the purpose of this study only those from Metropolitan Los Angeles were used. The companies which responded were divided into three groups. Group A consisted of companies which had one or more computers at the time of the survey. Group B was composed of companies which had no computer at the time but had a computer on order or expected to have one by 1965. Finally, Group C was comprised of companies which did not have a computer and did not expect to obtain one, but had unit record equipment of some type.

Most of the replies were from companies concerned with business applications of computers. The types of companies included Oil, Real Estate, Department Stores, Insurance, Securities, manufacturing, and Banking. The types of applications included payroll, accounts receivable and payable, inventory control, production and quality control, statistical, and sales analysis.

Computers were grouped into three classes: (1) those computers which had a normal lease price of over $10,000 per month classed as large, (2) those with a monthly lease from $3,000 to $10,000 classed as medium, and (3) those under $3,000 classed as small. About 30 different types of computers were included and about 12 different manufacturers were represented.

A copy of the questionnaire and the covering letter sent with the questionnaire are appended to this report as Appendix C.

Following is a summary of the responses to this questionnaire:

A Companies which have computers

B Companies which have no computer but expect to have one by 1965

C Companies which have no computer or plans for one

	A	B	C	Total
COMPANIES REPLYING	106	24	19	149
Types of applications				
Business only	67	21	15	103
Business and scientific or engineering	28	1	0	29
Scientific or engineering only	7	0	0	7
TOTAL	82	22	15	119

TYPES OF COMPUTERS	
Large (over $10,000 month lease)	25
Medium ($3,000 to $10,000 month lease)	40
Small (under $3,000 month lease)	112
TOTAL	177
NUMBER OF SYSTEMS PERSONNEL	
Programmers	937
Systems	522
Operators	725
TOTAL	2184

		A	B	C	Total
REQUIRE COLLEGE DEGREE (4 years)?					
Operator	Yes	4	0	0	4
	No	89	22	8	119
Programmer	Yes	26	1	1	28
	No	69	18	3	90
Systems Analyst	Yes	44	5	2	51
	No	47	15	2	64
Would you consider hiring a person with AA degree in Data Processing?					
	Yes	85	23	12	120
	No	14	1	1	16
What data processing courses do you think should be offered in the Adult School, Colleges, and Universities?					
Approve list in question 4		16	4	3	23
Accounting		8	2	1	9
Machine accounting		6	0	2	8
Punched card systems		13	2	3	18
Principles of data processing		9	1	0	10
Systems and procedures		15	2	4	21
Programming		30	5	6	41
Mathematics		14	3	2	19
English grammar and composition		5	2	1	8
Logic		5	1	0	6
Statistics		4	0	1	5

In question 2, various devices such as key punches, sorters, tabulators, duplicators, etc., were listed, but this data was not analyzed. In questions 3 and 4, the replies as to aptitude tests were also not analyzed.

In question number 4, as to hiring of a person with a two-year AA degree, several answered, "Yes, definitely".

In question 5, about half of the replies had remarks or suggested courses, some of which duplicated the list in question 4. A number of replies

signified approval of the list of courses in question 4. Several particularly approved of the courses in programming on two different computers. Those courses which were mentioned five or more times are listed in the summary.

It is significant to note that of the 136 companies responding, 120 (88%) said that they would hire persons with a two year Associate in Arts degree in Data Processing.

It is also significant to note that the list of data processing courses which most companies say should be offered agrees substantially with the list recommended in the documents, referred to earlier, suggesting appropriate courses for a data processing curriculum.

Report of Visits

One of the major aspects of the study was to gather information by means of personal visitations to junior colleges outside of the Los Angeles junior college district which have made or are in the process of making unique and significant preparations for the instructional and administrative use of digital computer equipment. It was obviously not possible to make extended visits to all the junior colleges meeting this criterion, and selection had to be based not only on the reputation of the college in this area but on feasibility considerations. Arrangements were able to be made to visit Orange Coast College, San Diego College, Monterey Peninsula College, and several junior colleges and vocational-technical schools in the state of Washington.

Orange Coast College

Orange Coast College opened its doors in September, 1948 on the site of the former Santa Ana Army Air Base in Costa Mesa, California. Located in one of the most productive agricultural counties in the nation, the area is characterized by its rich farm lands as well as by its oil fields, its beaches; its harbors, and its growing industries. The voters of the junior college district have approved a "pay as you go" building plan, using an override tax for building purposes. The system is apparently working well, for Orange Coast College has what are probably the finest existing junior college facilities for computer equipment.

In September, 1963, Orange Coast College opened its Data Processing Center, a building devoted exclusively to instructional and administra-

tive uses of the digital computer and its peripheral equipment. The building, measuring 80 x 84 feet, houses the equipment and has one classroom. In addition to the classroom, the building contains a computer room, a unit record equipment room and a data preparation room. There are also faculty offices and a library. In addition to the above facilities for instructional use, space is provided for administrative records and equipment. A second floor of about 20 x 28 feet is used for storage. A plan of this building is presented later in this report.

An interesting feature of the computer room is the floor which consists of removable panels about two feet square and about one foot above the subfloor. Because of this removable floor arrangement, power lines can be run under rather than on top of the floor. This not only aids in keeping the room clean, but is a safety factor. Currently in operation are an LGP 30 computer, an IBM 1620 computer, and an IBM 1401 computer with line printer. Disk packs for the IBM 1620 are expected to be obtained in the near future.

The unit record equipment room houses a verifier, sorter, reproducer, collator, interpreter, and accounting machine. The equipment in the data preparation room includes 9 keypunches, 3 flexo-writers and an add punch. Desk calculators are also provided in the data preparation room.

Administration and instructional uses of the computer room are scheduled carefully to avoid conflict, but separate facilities for the other equipment enable the center to handle a large volume of work in an efficient fashion.

The Data Processing Center staff consists of four instructors, three from the Business Administration department, and one from the Mathematics department. A two-year curriculum in Business Data Processing is given which conforms to the course content recommendations of the U. S. Department of Education. One course in Work Experience requires that the student obtain gainful employment of at least fifteen hours per week. Scientific programming is offered both in a separate course and as part of an Engineering course. The purpose of offering the brief 10 hour programming course in the engineering class is two fold: (1) to familiarize the prospective engineer with computers and their capabilities; and (2) to introduce instructors in the engineering area to computers in order that they might assign problems to students which require a digital computer for solutions.

The college arranges for talented high school seniors to attend the introductory classes, and is currently working with Newport Harbor high school district in the inauguration of a pre-technical pilot course as an introduction to data processing at the high school level.

Due to the outstanding program given at Orange Coast College, this school has been selected by the NDEA to give summer institutes for Teachers of Business courses.

San Diego City College

One of the oldest of California's junior colleges, San Diego City College's history dates back to 1914 when junior college classes were offered on the campus of San Diego High School. In 1938 the San Diego Vocational Junior College was set up to meet a need for the development of post high school technical vocational skills, and in 1939 the San Diego Evening Junior College was established to provide opportunity for college work for those adults unable to attend day classes. Since that time the San Diego junior colleges have undergone several reorganizations and today encompass the main campus of San Diego City College, San Diego Evening College, and a new academic-emphasis college to be opened shortly. San Diego City College today serves about 3,000 full-time students and nearly 9,000 are served in the Evening College. As the San Diego colleges have a history of vocational-technical specializations to serve the needs of metropolitan San Diego, a visit to San Diego City College seemed appropriate.

Computer equipment at San Diego City College is housed in a standard classroom building. Two rooms have been converted for this purpose: (1) a computer laboratory, about 440 square feet, housing an IBM 1620 digital computer; and (2) a unit record equipment room, about 800 square feet, housing a keypunch, collator, sorter, reproducing punch, interpreter, and two accounting machines. Neighboring classrooms are used for instructional purposes.

The computer equipment at San Diego City College is not used for administrative purposes, but is restricted to instructional use.

A two-year Business Data Processing course is offered, with courses conforming generally to the recommendations of the U.S. Office of Education, referred to earlier. No courses especially designed for mathematics-science major are offered at present, but plans are being made for their inauguration.

Monterey Peninsula College

Located on a pine-covered peninsula which juts into the Pacific ocean, Monterey Peninsula College serves about 1,000 full-time students and another 2,000 part-time students. Founded in 1947, the college has developed in its short history broad curricular offerings in many areas. Reputed to have a fine program in data processing, the college was selected for visitation because of its laboratory approach to the subject and because it is in the unique position of being remotely located from commercial computer installations.

Computer equipment including an IBM 1620 digital computer is being temporarily but satisfactorily housed in bungalows. A two year program in Business Data Processing is offered, again with the courses following generally the recommendations of the U. S. Office of Education.

A significant feature of the program at Monterey is the offering of a repeatable course in the use of unit record equipment and another in the use of the computer, each repeatable to a maximum of four times. This increases substantially the amount of actual contact students have with the machine and helps to overcome deficiencies in actual machine experience which occur at many schools.

Although there are no commercial installations in the vicinity, students have opportunity to get acquainted with the popular IBM 1401 computer used in many business institutions by use of a 1401 simulator supplementing the 1620.

Two Year Institutions in Washington

The state of Washington currently provides two-year post-high school education in thirteen "community colleges" and seven "vocational-technical schools." Washington state has maintained a position of leadership in Vocational-Technical education since the first Smith-Hughes legislation in 1917. These vocational-technical services cover four basic areas: agricultural education, trade-industrial and technical education, distributive education, and home and family-life education. Although the community colleges and vocational schools take somewhat different approaches to vocational education, there are more similarities than differences in the training provided in the vocational-technical areas. Today, five of the community colleges offer substantial programs in vocational-technical education, and most of the others have some training in this area.

In general, the vocational-technical schools emphasize training in more specific occupations, offer year-round programs permitting the student to complete his education in a shorter time, and offer few general education courses as compared to the community colleges.

The total operational cost for providing a vocational-technical program in the State of Washington is about $850 per year per full-time student. Most of this cost is borne by state taxes, with some assistance from Federal appropriations and local taxes. Students pay tuition fees

averaging $40 in the vocational schools and $160 in the community colleges.

The following two year colleges in the state of Washington were visited during the course of this study:

(1) Centralia College, Centralia, Washington, serving about 850 students, 90 of whom are enrolled in vocational-technical curricula.

(2) Clark College, Vancouver, Washington, serving about 1,600 students, more than a third of whom are enrolled in vocational-technical curricula.

(3) Olympia Vocational-Technical Institute Olympia, Washington, a small downtown technical school serving less than two hundred students.

(4) Tacoma Vocational-Technical Institute, Tacoma, Washington, the largest vocational school in the state, serving about 1,700 students.

Each of the schools visited had a sorter, tabulator, collator, and reproducing punch as well as an IBM 1620 computer. Two of the schools each had two disk-packs. In all, eleven schools in the state of Washington offer a Business Data Processing curriculum. Each has the basic unit record equipment and a 1620 computer. Some have disk packs and some will have line printers in the near future. Between 20 and 40 students are enrolled in the Business Data Processing curriculum at each of these schools.

The operation at Tacoma is unusual in that students can enter at any time of the year. Two classes of 20 students each are in progress, and a waiting list of about twenty is used to fill vacancies because of graduation, dropout, or dismissal. The curriculum can be completed in less than two years since a student may work at his own speed.

Olympia Vocational-Technical Institute is a small school of less than 200 students, of whom about twenty are enrolled in the Business Data Processing curriculum. Yet Olympia is furnished a full supply of equipment, including an IBM 1620 computer!

In addition to the regular program at Centralia College, students use an IBM 1401 simulator for the 1620 which enables them to learn how to operate a 1401 computer. Part of the instruction is then to go into the state offices at Olympia several times during the year and actually operate the 1401 computer there. At Centralia, another feature is that students "program" problems for the high school district on a "job" basis, with the instructor apportioning the "jobs" to the students. Grade point averages for the high school students are computed at Centralia also.

The vocational laboratory type of approach to the curriculum of Business Data Processing in the state of Washington is impressive. The competence of students completing the program appears to be of high order and the employment rate for these students is practically 100%.

Report from Conferences

In February, 1963, the Bureau of Business Education of the California State Department of Education sponsored at Fullerton, California a conference on Business Data Processing. In February, 1964, a similar conference was held at San Francisco. At these conferences, several junior colleges presented summaries of their current status in fields relating to the electronic digital computer, both as to curricula and courses being offered and as to equipment available. The following tables summarize the information presented at the 1964 conference.

Business Data Processing courses given by the three California schools visited are as follows: (figures are hours per week)

	Orange Coast		San Diego		Monterey Peninsula	
	Lect.	Lab.	Lect.	Lab.	Lect.	Lab.
First Semester						
Introduction to Data Processing	3	2	3		2	
Accounting	4				3	
Introduction to Business	3		3		3	
Second Semester						
Accounting	4		4		2	
Data Processing Machines	2	4	3	2	2	2
Data Processing Mathematics	4					
Programming					2	2
Third Semester						
Data Processing Machines	3	5	3	2	2	2
Cost Accounting	3					
Accounting			4			
Programming	3	2			2	2
Data Processing Machines projects					1-3	*
Computer projects					1-3	*
Fourth Semester						
Systems and procedures	3		3		2	2
Programming	3	2	3	2	2	2
Data Processing work experience	1	15				
Data Processing machine projects					1-3	*
Computer projects					1-3	*
Statistics	3					

* Monterey Peninsula College requires a minimum of 3 units in Data Processing machines and computer project, but either may be taken to a maximum of four times. Laboratory hours are arranged in addition to the lecture hours and vary with the project.

The numbers of students enrolled in Business Data Processing classes as reported by some California junior colleges is given in the following table:

	Intro. to DP		DP Machines		DP Math.		Comp. Prog.		Sys.& Proc.		Total		Grand
	Day	Eve.	Day	Eve.	Day	Eve.	Day	Eve.	Day	Eve.	Day	Eve.	Total
Long Beach	71	76	87	86			19	178	11		188	340	528
Foothill	119	190	42	50			30	26	15		206	266	472
Fullerton	84	58	19	15	35	16	24	12	10		172	101	373
American River	112	100	36	31			29	31	10	22	187	184	371
Orange Coast	72	100	50	84	58		56	111	23		257	295	552
San Diego	(Totals only available)										200	512	712
Fresno	(Totals only available)										67	54	121
Grossmont	48	69	23	17				12	58		71	156	227
Citrus	(Totals only available)										37	162	199
Modesto	30	36	37	103			10		21		77	160	237

The following table indicates the equipment available, as reported by several California junior colleges for the purpose of teaching Business Data Processing:

	Long Beach	Foothill	Orange Coast	San Diego	Citrus	Modesto
Key Punches	7	6	9	1	3	3
Add Punches	1		1			
Flexowriters	1		3			
Verifier	1		1		1	
Sorter	1	1	1	1	1	1
Collator	1	1	1	1	1	1
Interpreter	1	1	1	1	1	
Reproducer	1	1	1	1	1	1
Acctg.Machine	1	1	1	2	1	1
Calculator	1		1			
Computer	1	1	3	1	1	1

At the 1963 conference, Mr. Lee Baldwin of the Bureau of Business Education, California State Department of Education, reviewed a set of evaluative criteria for Business Data Processing programs. These guidelines should prove useful in the Los Angeles junior colleges and are presented in this report as Appendix E.

V. RECOMMENDATIONS

Curriculum

It is clear that the junior college will play an increasingly significant role in educating students for the "age of the computer." Those junior college students requiring some sort of training related directly to the computer can be classified broadly into the following groups:

A. Business Data Processing Vocational-Technical Majors

B. Computer maintenance and repair Vocational-Technical majors

C. Business administration transfer majors

D. Physical science, mathematics, and engineering transfer majors

E. Life science and social science majors

F. Part-time evening students

Let us consider the needs of each of these groups of students.

A. Business Data Processing majors

Vocational-technical majors in the Business Data Processing curriculum need two full years of specialized training in order to be prepared for specific jobs. The curricula discussed earlier in this report have indicated consistency of agreement in the specific courses to be included in the curriculum. Major disagreements seem to be in the emphasis placed upon time spent by the student in laboratory situations involving direct use of the computer and its auxiliary equipment. Based on the findings in the state of Washington, it seems desirable that students spend a considerable amount of time in the laboratory working on problems such as those encountered on the job. The program at Monterey Peninsula College offering repeatable courses approaches this objective. In any case it is strongly recommended that emphasis be on practical experience

and a large portion of the student's time be spent in actual operating of the computer and its peripheral equipment. It is suggested that a different type of degree, the A.T. (Associate in Technology) might be appropriate for these students.

It is strongly urged that the vocational-technical curriculum in Business Data Processing be not considered a terminal course in the literal sense, but that students be urged to continue their education as they are able. In the rapidly changing computer age, continuing education is essential.

B. Digital Computer Technology majors

Training for those who plan to be computer maintenance and repair technicians is not considered in this study. A curriculum in this area is being developed by Dr. Bernhard Fischer at Los Angeles City College and a report on this activity should be forthcoming shortly. Equipment used in the digital computer technology program will on occasions not be in operating condition, and use by other departments would probably be restricted by tight scheduling.

C. Business Administration transfer majors

With most of their time accounted for by lower division transfer requirements, those students who plan to transfer to a four-year college or university obviously cannot meet the requirements of extended laboratory work recommended for the Business Data Processing majors. The requirements of the modern business world, however, demand a minimum of knowledge of the computer and its business uses. It is recommended that

Business Administration transfer majors have a minimum of six units of Data Processing and Computer Programming. This requirement could be met by the three unit Introduction to Data Processing and the three unit course in Programming taken by the Business Data Processing majors. In the larger colleges, it is hoped that separate courses especially designed for these students can be offered.

D. Physical science, mathematics and engineering majors

Those students planning to major in physical science, mathematics, and engineering have heavy lower division requirements and, barring a wholesale revision of the upper division curricula, have little time for additional courses. However, most upper division institutions now assume some knowledge of the computer on the part of these majors, and they must have some lower division work in the area if they are not to fall behind. For example, part of UCLA's Engineering 4B, a required course during the high freshman year, now includes an introduction to the computer and students should be able to program for the department's Bendix G-15 or IBM 1620 well before the junior year. California State Polytechnic College in San Luis Obispo, as another example, has a Bendix G-15 and an IBM 1620 and offers lower division programming courses for science and engineering students.

It is recommended that at least a three unit course in computer programming be offered to the physical science, mathematics, and engineering majors. This course should be different from the course offered to the Business Data Processing majors. In the business course, emphasis is on output and much detail related to business is necessarily included. The

course recommended here should emphasize programming of mathematical problems, considering more intricate and sophisticated techniques than the business course. For those students considering mathematical or scientific programming as a career, the offering of a second semester more advanced course would be desirable.

E. Life Science and Social Science Majors

Although possibly going into fields not requiring specific knowledge of computer operation, majors in life science and social science, along with competent students in almost any other major, should have opportunity to take a "general education" course dealing with the computer and its impact on modern society. It is conceivable that those qualified or interested might take the programming course recommended above for physical science, mathematics, and engineering majors. Also, those that are qualified or interested could take the programming course designed for the Business Data Processing majors. Where feasible in the larger institutions, however, it is suggested that a three-unit general education course could be beneficial and attractive .

A one-unit "appreciation" course is now being offered at Los Angeles City College. Programming in this course is restricted to simplified devices such as Fortran or Algol (i.e., instructions are written in simple algebraic-like form). The course has proved to be popular and often serves as an inspiration for students to take a more thorough course.

Of twenty-two students in a recent class, stated majors included Business Data Processing, Business Administration, Mathematics, Pre-Engineering, Electronics, Pre-Optometry, English, Pre-Medical, and Pre-Law.

F. Part-time Evening Students

As can be observed from enrollment figures given earlier in this report, the Los Angeles junior colleges serve a large number of part-time evening students. To meet their needs, and also to obtain maximum use of the computer equipment, it is to be hoped that all of the programs and courses recommended above can be offered in the evening as well as the day.

In addition, special courses may be given for employed persons who wish to advance on their jobs. Here advantage can be taken of the fact that some manufacturers have equipment not in use at night and are often willing to cooperate with schools in the use of this equipment. Metropolitan College is already providing a community service in this regard. It is hoped that this can be continued and possibly expanded. This particular type of service is possibly more appropriate to Metropolitan College than the other Los Angeles colleges considering the nature and location of the institution.

Administrative and other Uses of Equipment

Although this study is primarily concerned with instructional use of computers, consideration must be given to other uses. Installation and maintenance of computer equipment is costly and every effort should be made to utilize the equipment to its maximum capacity. This is especially true in smaller schools where instructional use or administrative use alone might not justify a particular piece of equipment but a combination of uses might make it obtainable.

Possible administrative uses of the computer are almost innumerable. Salaries, work allocation, student attendance, student scheduling, room usage, grade reporting, permanent recording are only a few which come to

mind immediately. In most of the schools visited, the computer equipment is being used both by instructional departments and administration. At the recent San Francisco meeting, several schools indicated that they are contemplating use of late evening and early morning hours for administrative uses of the computer, freeing the computer during the day for instructional use while necessitating only one or two persons to work the "third" shift.

The computer and its associated equipment can be of invaluable aid to a college in its program of institutional research. Studies of student characteristics, prediction of success by tests and other instruments, follow-up studies and other research vital to effective and efficient administrative decision-making can be performed for maximum benefit to the institution only with the help of computer equipment.

Aids to instructors of classes not directly related to the computer are possible and worthwhile. For example, in the teaching of courses in finance, tables are not available for certain rates of interest which may be in commercial use (e.g., 4.85%). These tables can easily be prepared using a computer.

Physical Facilities

In light of the tremendous current and future importance of the computer and its college-wide uses, a major recommendation of this study is that separate facilities housing all computer equipment be provided on each of the seven campuses of the Los Angeles junior colleges. Six of the seven colleges now have at least one computer, and several have considerable auxiliary equipment. It is proposed that a Data Processing Center be established on each campus.

Among the advantages of a Data Processing Center on each campus are the following:

1. Unnecessary duplication of equipment is avoided.
2. Policing of the equipment could be done by clerical help rather than by the instructors.
3. Student workers could be utilized to help beginners, again reducing the amount of time spent by instructors.

On the following pages are several suggestions for possible layouts for a Data Processing Center. Layouts for a unit record equipment room and for a unit record equipment room and for a computer laboratory as suggested by the Office of Education are presented first, followed by a plan of the Orange Coast College Data Processing Center. Finally a layout using a regular classroom building is suggested.

The following points are recommended in designing a Data Processing Center, whatever the basic layout:

1. Equipment should not be housed in a classroom. It should be available for use at any hour of the day and not be tied up by classes using the room.
2. Closed circuit television between computer and classroom is an effective means of enabling an entire class to watch computer operation.
3. Upper portions of walls between offices, machine rooms, work rooms other than classrooms should be glass so that one person can supervise operations in several rooms. Glass partitions between classrooms and machine rooms would be desirable if some sort of shade or venetian blind were installed so that it could be closed when desired.

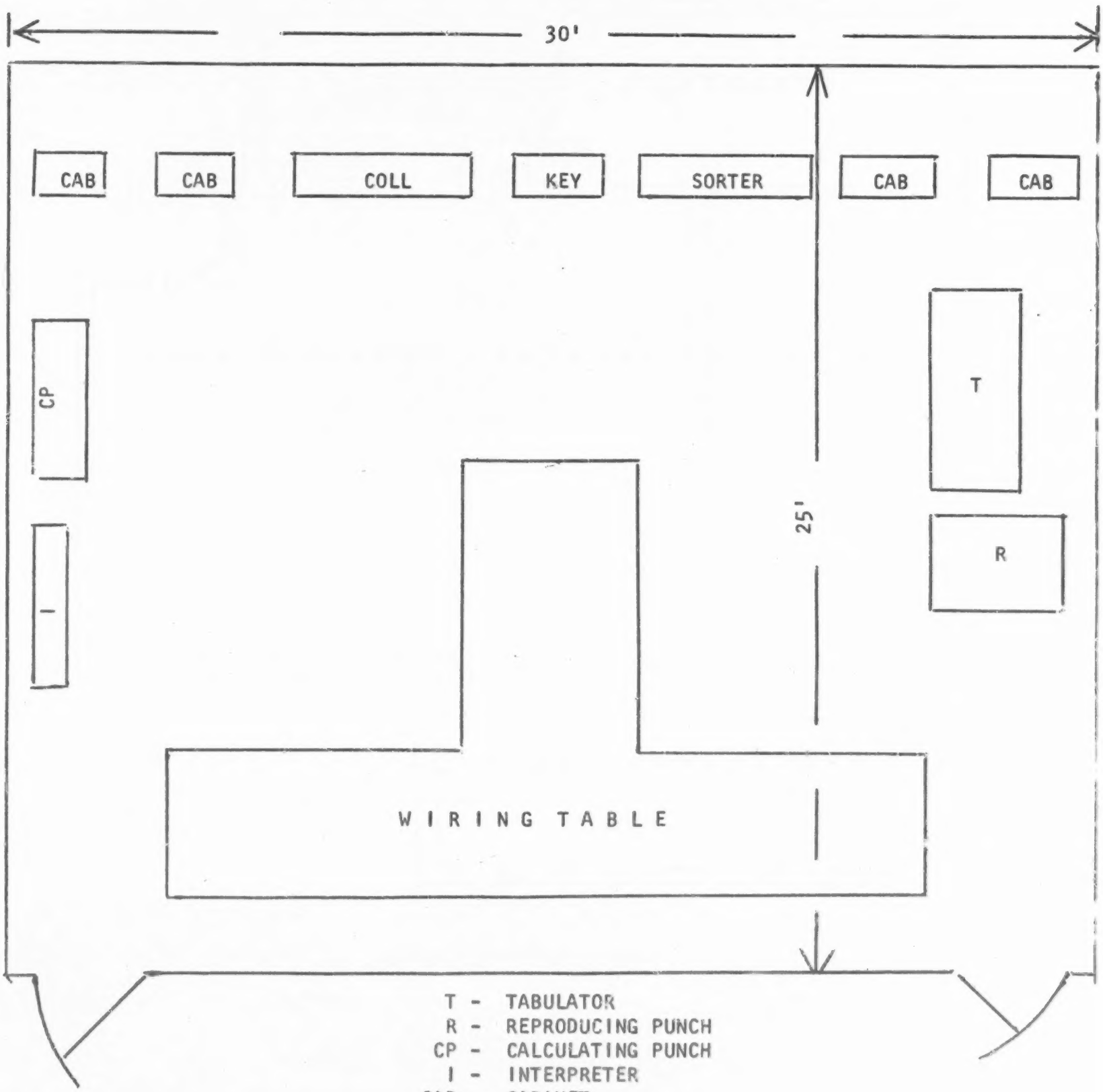
4. The computer and machine-room floor should consist of removable panels with about a one foot recess so that connections between machine can be easily made and changed when desired. As this eliminates cables to and between machines, it is also a safety factor.
5. A library for manuals on the equipment available and other equipment, periodicals, texts, and other relevant material should be maintained. Quoting from reference 1,

> "A library work center is a necessary part of the data processing facilities. It should be located close to the data processing equipment, preferably as a section of the laboratory or in an adjoining room."

The layout using the regular classroom building is rather flexible and has some points of merit:

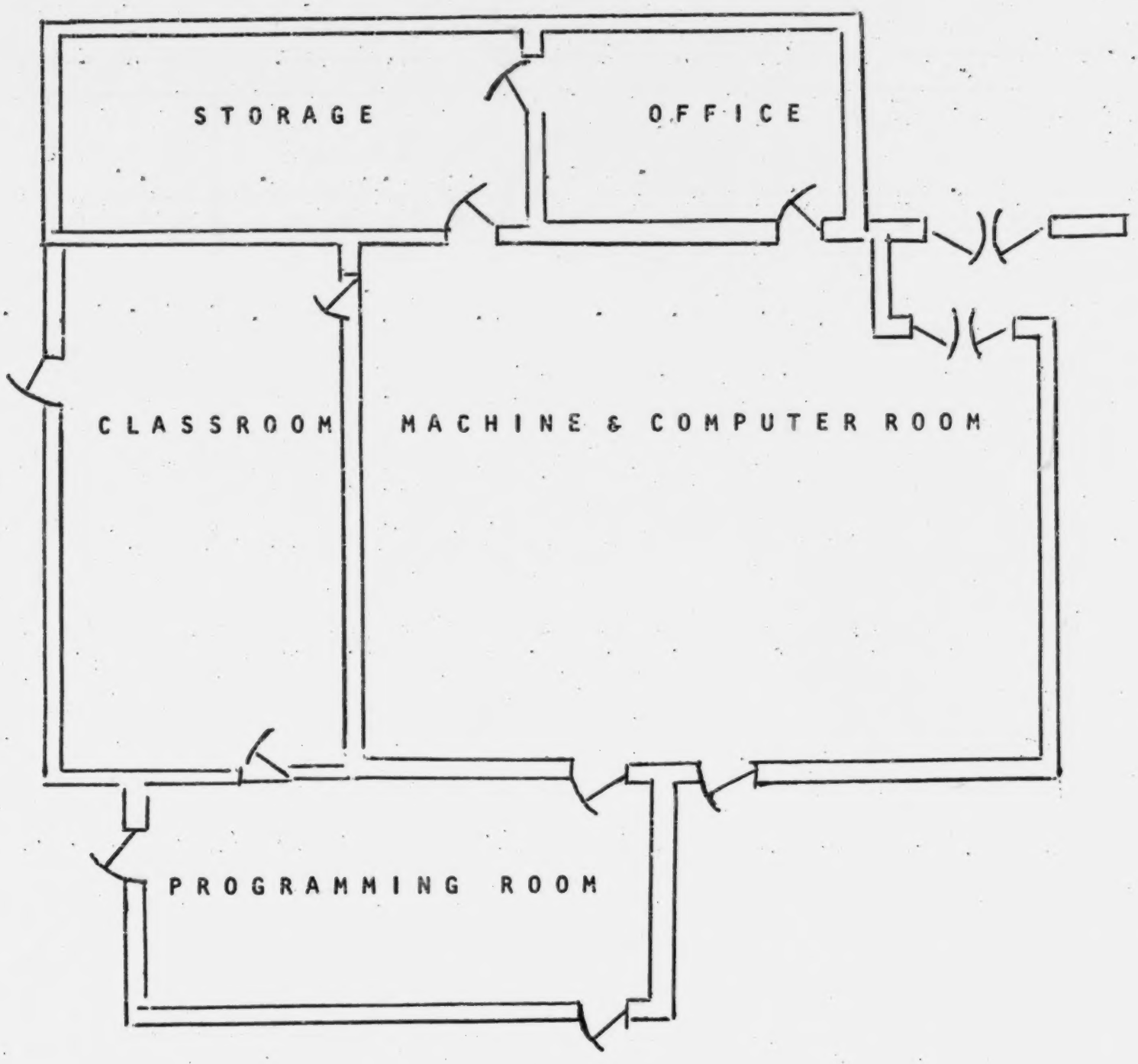
1. The data processing center could be housed in standard room arrangements. Smaller schools could use the same idea and reduce the number of rooms by combining functions.
2. Since in the teaching of unit record equipment there is a tendency to concentrate on one machine for several weeks, then to move on to another, and since some unit record equipment is not difficult to move, a room for administrative use and one for instructional use next to each other would be an economical arrangement.
3. A combined room for a programming laboratory and use of desk calculators would be an ideal arrangement, since then students could test programs by running them on the calculators. This room might be used for instruction on desk calculators a few hours per week and be open to students the balance of the time.

Suggested layout for a unit record equipment room, from reference 1, page 45.



T - TABULATOR
R - REPRODUCING PUNCH
CP - CALCULATING PUNCH
I - INTERPRETER
CAB - CABINET
COLL - COLLATOR

Suggested layout for computer laboratory from reference 1, page 49



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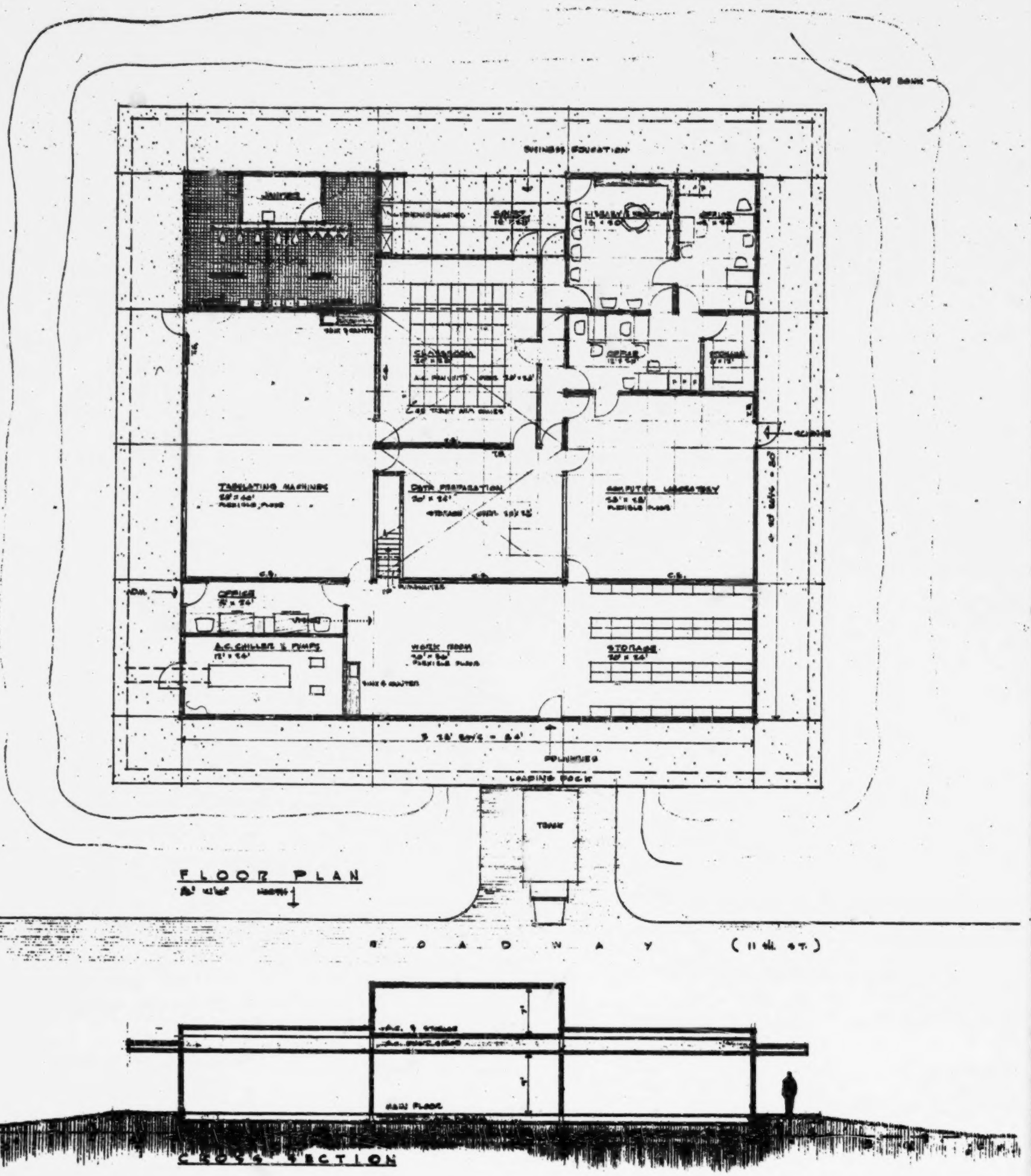


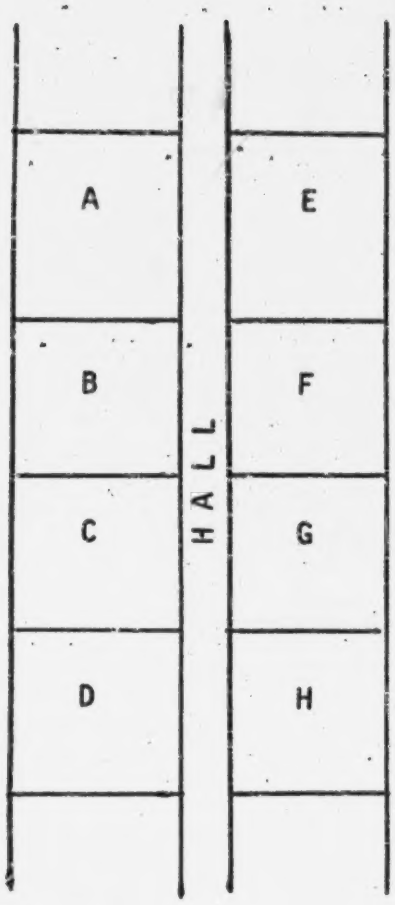
DATA PROCESSING CENTER

ORANGE COAST COLLEGE

costa mesa california

BE BIUROCK ELLERBROEK AND ASSOCIATES
ARCHITECTS

LAYOUT FOR A JUNIOR COLLEGE COMPUTING CENTER



A standard classroom building could be made into a computing center with very little alteration. If a new building were built in this manner it would have considerable flexibility, since if the data processing classes declined, the rooms could be easily reconverted into classrooms.

A. Administration Offices and records.

B. Administration records and equipment.

C. Instructional unit record equipment.

Since B and C are adjacent, small pieces of equipment might be moved from one to the other to meet needs. Administration could use room C when no classes were being held.

D. Keypunches, addpunches, flexowriters and board wiring room.

E. Faculty Offices and Library.

F. Programming, laboratory and desk calculators and adding machines. This room used a few hours per day for classes on adding machines and desk calculators. Other times open to students for preparation of programs and use of calculators.

G. Computer room.

H. Classroom.

Service to the High Schools

The opinion seems to be growing that high schools should offer some training in computer programming and/or data processing and that the junior college is often in a position to be of service in this regard. Oakland High School District recently purchased five used Bendix G-15 computers for use in high school classes. During the course of this study the Los Angeles district established two Saturday morning classes for high school students to be held on the premises of a computer manufacturer.

Some thought should be given to teaching the subject in high schooi as a part of the regular curriculum rather than as an extra curricular activity. High schools could easily give courses which do not require laboratory, such as the Introduction to Data Processing. Laboratory courses might be given to high school students in one or more of the following manners:

1) An "honors program" arrangement whereby talented high school students come to the junior college and take the particular class. This is now being done in classes in mathematics and other subjects
2) Classes with lecture portion at the high school and laboratory portion at the junior college
3) If data processing equipment is rugged enough to stand transportation by trailer (at least one manufacturer indicates this to be true), a data processing trailer might serve several high schools and the high school would need only keypunches or input devices to be ready for the periodic visit of the trailer. One such unit should be able to serve five to ten high schools.

Teachers for the Program

Instructional staffing for computer programs is a problem not to be taken lightly. Few teachers on the regular junior college faculties at present are competent to teach in the program without some in-service training. The use of untrained industry personnel has generally not proved satisfactory. A small supply of competent young teachers is arriving on the scene but not in nearly enough quantity.

It is recommended that experienced teachers, of business and mathematics especially, be encouraged to take in-service training courses in order to prepare to teach computer courses. One excellent in-service training session is the six weeks course given at Orange Coast College funded by the National Defense Education Act. Interested persons are urged to contact Orange Coast College for details.

Costs of the Programs

To assist in estimating the cost of "hardware" for a Business Data Processing curriculum, the table below has been prepared with costs based on current IBM monthly lease prices. The cost per student per month assumes a 20% educational discount. If federal or other funds are available, these costs would of course be reduced. The equipment recommended is based on experiences reported in this study.

Number of Students	Equipment	Monthly Lease Price	Sub Total	Cost per Student Per Month
50	Keypunch	$ 60.00		
	Sorter	40.00		
	Collator	95.00		
	Verifier	50.00		
	Reproducing punch	70.00		
	Interpreter	100.00		
	Accounting Machine	225.00		
	Computer	2310.00		
		$2980.00	$2980	$ 47.68
100	Key punch	60.00		
	Disk-pack	800.00		
		$ 860.00	$3840	$ 30.56
150	2 Key punches	$ 120.00	$3960	$ 21.02
200	Key punches	$ 60.00		
	Line printer	710.00		
		$ 770.00	$4730	$ 18.40

Computer programming courses for mathematics, science, and engineering students have been given at Los Angeles City College for about five years. Based on this experience and that of others, the following table is presented as an estimate of costs of "hardware" for this program. This table assumes an average input time per student of 25 minutes per week and about 5 minutes per week of calculation and output time. Input devices include keypunches, add punches, and flexowriters. Assuming the computer in operation 30 hours per week for this purpose, the cost per student per month is:

Number of Students	No. of Input Devices	Cost per Student per Month
60	1	$ 30.00
120	2	15.50
180	3	10.70
240	4	8.30
300	5	6.80

The cost per student per month for the mathematics-science computer programs is less than that for the Business Data Processing program, since the unit record equipment is not needed and the student requires less time on the computer. If both programs are in operation, the cost per student per month would lie somewhere between figures given in the two cases.

Another important question relating to costs is whether to lease or purchase the equipment.

Advantages of Leasing

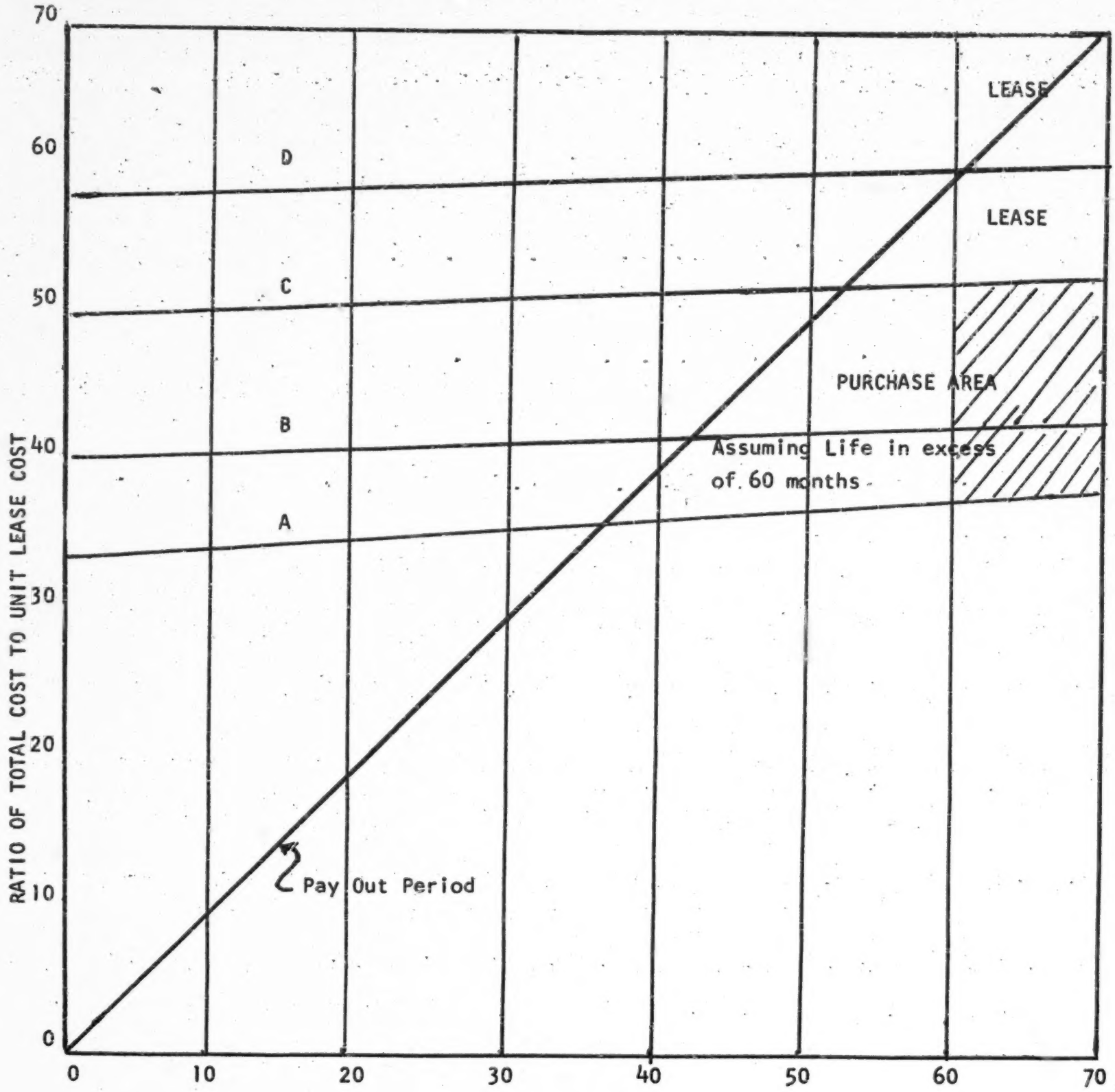
Some aspects of the lease or buy question have been considered by William E. Perry in an article, "Managing the Cost of Computers" in Administrative Management, November, 1963. He gave the hourly cost for several different alternatives.

1.	Outright purchase	$ 41.20
2.	Rental or leasing	56.80
3.	Lease-back (5 yr. commercial lease)	51.10
4.	Purchase main frame--lease others	51.10
5.	Purchase time from a service center	75.00
6.	Purchase time from a user	60.00

An alternative which was not considered above is that of installing data transmission lines to a large computer. However, this is very expensive, for the sending-receiving station is either a computer or a piece of equipment as expensive as the type of computer used in junior colleges. The situation in which this alternative is a good solution is that of a school which occasionally has highly complex problems.

One other alternative is to use equipment of a manufacturer on his premises. This is quite satisfactory for night classes, but the equipment is not usually available during the day.

DETERMINATION OF LEASE OR PURCHASE PREFERENCE



Note: The inclinationsof lines A, B, C and D reflect increasing costs due to maintenance. Without considering the value of money, the cost of purchase, lease and maintenance for the equipment of several manufacturers is considered in the table above. To facilitate comparison, all prices were reduced to ratios to the monthly lease price. The diagonal represents the line of increasing period for pay-out. Purchase is recommended if the equipment expects a useful life extending into the shaded area.

The ratio of purchase price to monthly lease price for several manufacturers varies generally from 30: 1 to 50: 1. In order to compare the alternatives, we should consider the value of the equipment at the end of the period, and the value of money. The following table is based on a 40 to 1 ratio of purchase to lease price and shows the number of months for purchase and lease to be equivalent.

		SCRAP VALUE					
		0%	5%	10%	15%	20%	25%
Value of Money	0%	40	38	36	34	32	30
	3%	42	40	38	36	33	31
	4%	43	41	38	36	34	32
	5%	44	41	39	37	34	32
	6%	45	42	40	37	35	32
	7%	46	43	40	38	36	33

Since equipment can be used for at least five years in the junior college situation, it appears that under the above conditions purchase is more economical than lease.

If the ratio becomes greater than 50 to 1, then lease certainly seems more advantageous. (This recommendation is outlined graphically in the chart on the foregoing page.)

Option 4 above (purchase computer - lease other devices) has certain advantages since input devices probably will change more than computers. Mark-sensing or other methods of input may lessen needs for card punches, etc.

At this writing, the implementation of recent federal legislation and its effect on the financial picture are not clearly known. This may have considerable impact and should be followed carefully, since reimbursement and manufacturers' discounts dramatically alter the ratio of purchase to lease costs.

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VII. APPENDICES

A. Glossary of terms

B. References

C. DPMA Questionnaire

D. List of computer manufacturers

E. Bureau of Business Education
Evaluative Criterion

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APPENDIX A

Glossary of Some Terms Used in this Report

Accounting machine
: A machine which does limited arithmetic, does not have decision-making ability, used primarily for tabulating and printing

Add punch
: An adding machine with a punch for paper tape attached

Calculating punch
: A machine which calculates and punches results of calculations on cards (sometimes called a calculator)

Calculator
: An ordinary manual or electric desk calculator

Collator
: A machine for comparing, sequencing, or matching punched data cards

Computer
: An electronic digital computer

Disk pack
: A machine for storing information and making it readily available when needed

Flexowriter
: A typewriter which punches paper tape for use with a computer

Hardware
: A computer and its related machines; a configuration of machinery

Interpreter
: A machine which prints in English at the top of a punched data card the information punched in it

Keypunch
: A machine to punch information into data cards by use of a keyboard

Line printer
: A machine which prints computer output an entire line at a time

Magnetic tape system
: A machine for storing information, sequentially programming, preparing instructions for a computer

Reproducer
: A machine which duplicates a deck of punched cards; also punches cards to match pencil-marked cards

Glossary of Some Terms Used in this Report (continued)

Software
Programs, language processors, tape libraries and other devices to aid in operating computers

Sorter
A machine to sort punched data cards

Unit record equipment
That group of machines, other than a computer, which operate on punched cards; often called electro-mechanical machines

Verifier
A machine for checking the accuracy of punched cards

APPENDIX B

References

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NATIONAL MACHINE ACCOUNTANTS ASSOCIATION

LOS ANGELES CHAPTER
P. O. BOX 1047, HOLLYWOOD STATION
HOLLYWOOD 28, CALIFORNIA

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Enclosed is a 1962 NMAA Annual Data Processing Survey Form. For your convenience and ease of completion, the form has been kept brief, and a return pre-addressed envelope enclosed. It would be sincerely appreciated if you could find time to fill out this form.

The survey is a basic part of the National Machine Accountants Association's (NMAA) Data Processing Educational Activities; some of which are as follows:

1 - Publication of the NMAA Data Processing Course Directory every semester (94 pages of Data Processing Class Information for Spring, 1962.

2 - Issuance of Local and National Certificates in Data Processing.

3 - Sponsoring of Data Processing Seminars in the Local Colleges.

4 - Organizing and staffing of Data Processing Courses in the Adult School, Colleges, and Universities.

5 - Serving of members on State Business Data Processing Education Advisory Committees and Conferences.

6 - Furnishing of speakers for Data Processing Educational Activities.

Thank you,

Kenneth B. Parsons
Director of Education, NMAA

NMAA ANNUAL DATA PROCESSING SURVEY

1) Company Name & Location: (optional)

_____ _____

_____ _____

Type Applications

COMPUTER INFORMATION

	Present	1963	Projected For 1964	1965
Name of Computer				
Configuration				
Number of Programmers				
Number of Systems Personnel				
Number of Operators				
Name of Computer				
Configuration				
Number of Programmers				
Number of Systems Personnel				
Number of Operators				

2) Other Type of Data Processing Equipment - - -

3) Requirements

Do your Require:	For Operations Personnel	For Programming	For Systems Analysts
An Aptitude Test			
A College Degree (4 yrs)			

4) Would you consider hiring a person with a two-year Associate of Arts College Degree in Data Processing (includes two semesters of Principles of Data Processing, two semesters of Programming on two different computers, one semester of Punched Card Accounting, one semester of Tabulating Management Systems, two semesters of Electronic Data Processing Systems, and various courses in Mathematics, Accounting, Business, and English) and without experience?_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Would you require the passing of an aptitude test also?_ _ _ _ _ _ _ _ _ _ _ _ _ _ _

5) What Data Processing courses do you think should be offered in the Adult School, Colleges, and Universities?_ _

_ _

_ _

_ _

_ _

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APPENDIX D

Major supplierers of digital-stored programmed computers for business, scientific, engineering, and process control are:*

1. Advanced Scientific Instruments Minneapolis
2. Bunker-Ramo Corp. Canoga Park, California
3. Burroughs Corp., Detroit
4. Clary Corp. San Gabriel, California
5. Computer Control Corp. Los Angeles
6. Collins Radio Corp. Dallas, Texas
7. Control Data Corp. Minneapolis
8. Data Systems, Inc., Detroit
9. Digital Equipment Corp., Maynard, Mass.
10. Electronic Associates, Inc. Long Branch, New Jersey
11. General Electric Co. Phoenix, Arizona
12. General Precision, Inc. Burbank, California
13. Hughes Aircraft Co. Fullerton, California
14. International Business Machines Corp., New York
15. Monroe Calculating Machine Co., Orange, New Jersey
16. Minneapolis, Honeywell, Wellesley Hills, Mass.
17. National Cash Register Co. Dayton, Ohio
18. Packard Bell Co. Los Angeles, California
19. Philco Corp., Willow Grove Pa.
20. Radio Corp. of America Camden, New Jersey
21. Scientific Data Systems, Inc. Santa Monica, California
22. Sylvania Electronics Systems Div., Needham, Mass.
23. Teledyne, Inc. Hawthorne, California
24. Univac Div. of Sperry Rand Corp., New York

* from Business Week, February 29, 1964

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APPENDIX E

Evaluative Criteria for a BDP Program

Prepared by Mr. Lee Baldwin of the Bureau of Business Education, State Department of Education.

Organization

1. The BDP program is designed to train students for useful employment in jobs as highly skilled technicians.
2. The program has a statement of objectives for the program.
3. The aims and objectives of the program are understood by administrators, counselors, faculty and students.
4. An advisory committee of employers and employees assists in the continuous planning and development of the program.
5. A planned recruitment program, including brochures, is provided.
6. Provision is made for student selection and placement within the program.
7. There is a good working relationship within the business department and coordination of the BDP program with other departments.
8. The program provides for the retraining needs of persons who may be replaced by technological developments.

Curriculum and Instruction

1. The curriculum provides for a sequence of technical and related courses.
2. Instruction is directed toward specific job preparation as well as a broad career objective in data processing.
3. A well-defined course of study is prepared and available.
4. The curriculum provides opportunities for students to solve typical business problems with the use of data processing equipment.
5. Instruction is based on an analysis of the types of work done by BDP technicians.
6. Provision is made for supervised work experience in a data processing installation.
7. Specialized training needs in the community are made available through extension courses.

Physical Facilities

1. There is adequate student work space in the laboratory.
2. Materials and supplies are available to meet enrollment needs.
3. Provisions are made for use of various types of audio-visual aids.
4. The laboratory equipment is used primarily for problem solving as opposed to machine mastery.
5. There is a laboratory assistant or some means available so that the laboratory facilities are open a sufficient number of hours to meet student needs.
6. Adequate and conveniently arranged storage space is provided for materials and equipment not in frequent use.
7. Library facilities are available in the laboratory for student use.
8. Financial support is given to the program as evidenced by equipment, facilities, and supplies.

Instructional Staff

1. Instructors have had adequate preparation in content of courses taught.
2. Instructors have had work experience in the processing of data and/or accounting.
3. Recent or continuing in-service training for new equipment and techniques has been taken by instructional staff.
4. An active interest in professional advancement, including participation in professional organizations, is maintained by instructors.
5. Within the instructional load sufficient time is provided for program development.
6. The instructional staff is supplemented by laboratory assistants.

Instructional Materials

1. A teacher's file of supplementary materials is maintained.
2. Appropriate instructional aids are available and used.
3. Well-selected and up-to-date reference books are readily accessible to instructors and students.

4. Samples of current data processing forms and records utilizing various systems are available.

5. Technical pamphlets, handbooks, and manuals are organized for efficient student use.

6. Self-study materials are available to use in connection with specific instructional needs of students.

Methods of Evaluation

1. There are records showing progress of individual students.

2. A record of student placement including job title and salary is maintained.

3. Follow-up studies of enrollees are conducted to evaluate educational outcomes.

4. Evaluation of the curriculum and individual instructional units is made with an advisory committee.

5. There is a record of the reason for student drop-out or those who may discontinue in the program for one reason or another.

6. The program is evaluated periodically in terms of the stated objectives.